REMARKS/ARGUMENTS

The applicant's attorneys appreciate the Examiner's thorough search and remarks.

Responsive to the objection against claim 9, claim 9 has been amended to call for "a substantially uniform concentration of P-type dopants". Withdrawal of the objection is requested.

Claim 9 has been amended to call for the following combination:

> 9. A power MOSFET having reduced on resistance comprising:
>
> a P type conductivity substrate; an epitaxially deposited N type conductivity layer deposited atop said P type substrate to form an epitaxial layer having a substantially uniform concentration of P-type dopants throughout its volume; a plurality of spaced trenches having vertical walls extending through said epitaxial layer; a thin gate oxide on said vertical walls and conductive polysilicon with a P type conductivity deposited into said trenches to define a polysilicon gate; a P type concentration source region formed adjacent the walls of each of said trenches and diffused into the top of said epitaxial layer; a source contact connected to at least said source regions; and a drain contact made of metal and connected to a bottom surface of said substrate, wherein the doping of said N-type layer allows voltage to be blocked therein.

The device disclosed by Floyd does not operate based on conventional principles. To be precise, Floyd states that unlike conventional devices, in Floyd's device blocking (i.e. reverse voltage blocking) "is achieved by a <u>gate controlled</u> depletion barrier and <u>not by a quasi-neutral</u> PN junction" (Col. 2, lines 11-12). Floyd defines "quasi-neutral" as undepleted "PN junction at a Vgs (gate source voltage) of zero." That is, Floyd says that its devices do not prevent breakdown by relying on the conductivity of the P and the N regions in the PN junction (base region and substrate) of the device.

According to Floyd, the breakdown mechanism of the disclosed device is not determined by the well known avalanche breakdown mechanism. Rather, Floyd offers a new arrangement which Floyd summarizes as follows:

> Advantageously in the blocking state the epitaxial P body region is depleted due to the applied drain-source bias V_{ds}, and hence a punch-through type condition occurs vertically. However, lateral

> gate control combined with the narrow mesa width (under 1.5 μm) increases the effective depletion barrier to majority carrier flow and prevents conduction. Thus, the present device is referred to herein as the PT-FET for "punch-through field effect transistor." Col. 2, lines 41-49.

The details of the mechanism are set forth in Col. 4, line 27- Col. 5, line 9.

There are two points to note. First, in a device according to Floyd the conductivity of the base region is selected to deplete out to achieve what is called a punch-through condition. Indeed, Floyd calls its device a PT-FET or punch-through field effect transistor.

On the other hand, in a device according to the present invention the conductivity of the base region is selected to prevent breakdown or complete depletion. Claim 9 has been amended to reflect this difference in the principle of operation. Specifically, claim 9 calls for the voltage to be blocked in the channel region. A basis for the amendment is found on page 4, lines 8-11.

Second, Floyd says that it

> has been found by the present inventors that a P-type polysilicon gate electrode for an N-channel device (that is, the polysilicon gate electrode having the same conductivity type as the adjacent body region) is highly beneficial. <u>The P-type polysilicon gate electrode allows the body region to remain fully depleted</u> while it enhances the energy barrier to reduce leakage to acceptable levels (levels superior to those of the ACCUFET). Col. 4, lines 48-55.

It should be further noted that claim 9 calls for an N-type epitaxial body, and a P-type gate. It is clear, however, that in a device according to Floyd having a gate electrode with the same plurality as the base region (called body region in Floyd) is necessary to keep the body region fully depleted. It is suggested that in a device according to Floyd's disclosure keeping the body region fully depleted is necessary to keep leakage current down to acceptable levels. Although Floyd does not clearly explain the principles behind the design of its device, one can deduce the principles behind Floyd's device by reference to well known phenomenon. Specifically, it is known that avalanche breakdown occurs when carriers are accelerated to a point where ionization occurs. A source of carriers in the depletion zone under reverse bias is the leakage current. Thus, as the reverse voltage increases carriers are pushed to a point where ionization occurs and avalanche takes place. Naturally, if leakage current is lower there are fewer carriers to act as agents of ionization. It would be reasonable to include that in a device

according to Floyd it is critical to suppress the leakage current to deplete the depletion zone as much as possible to decrease the rate of ionization and thus prevent avalanche for as long as possible. That being the case, a skilled person would find it important to not change the polarity of the gate electrode in a device proposed by Floyd.

Thus, in Floyd, the conductivity of the gate electrode 52A, 52B must be the same as the conductivity of the base region 42 in order for the device to work properly. Because Floyd says that it is important to have gate electrodes of the same conductivity as the channel region, one skilled in the art would be directed away from changing the conductivity of the gate electrodes in Floyd to a polarity that is opposite to the base region. Given that the Examiner has not given a reason why a skilled person would change a critical parameter (i.e. gate electrode polarity) in Floyd, the record lacks a case of obviousness (i.e. lack of inventive step). Reconsideration is requested.

The application is believed to be in condition for allowance. Such action is earnestly solicited.

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Kourosh Salehi
Name of applicant, assignee or Registered Representative

Signature

April 30, 2007
Date of Signature

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Respectfully submitted,

Kourosh Salehi
Registration No.: 43,898
OSTROLENK, FABER, GERB & SOFFEN, LLP
1180 Avenue of the Americas
New York, New York 10036-8403
Telephone: (212) 382-0700